

Aug. 2, 1960

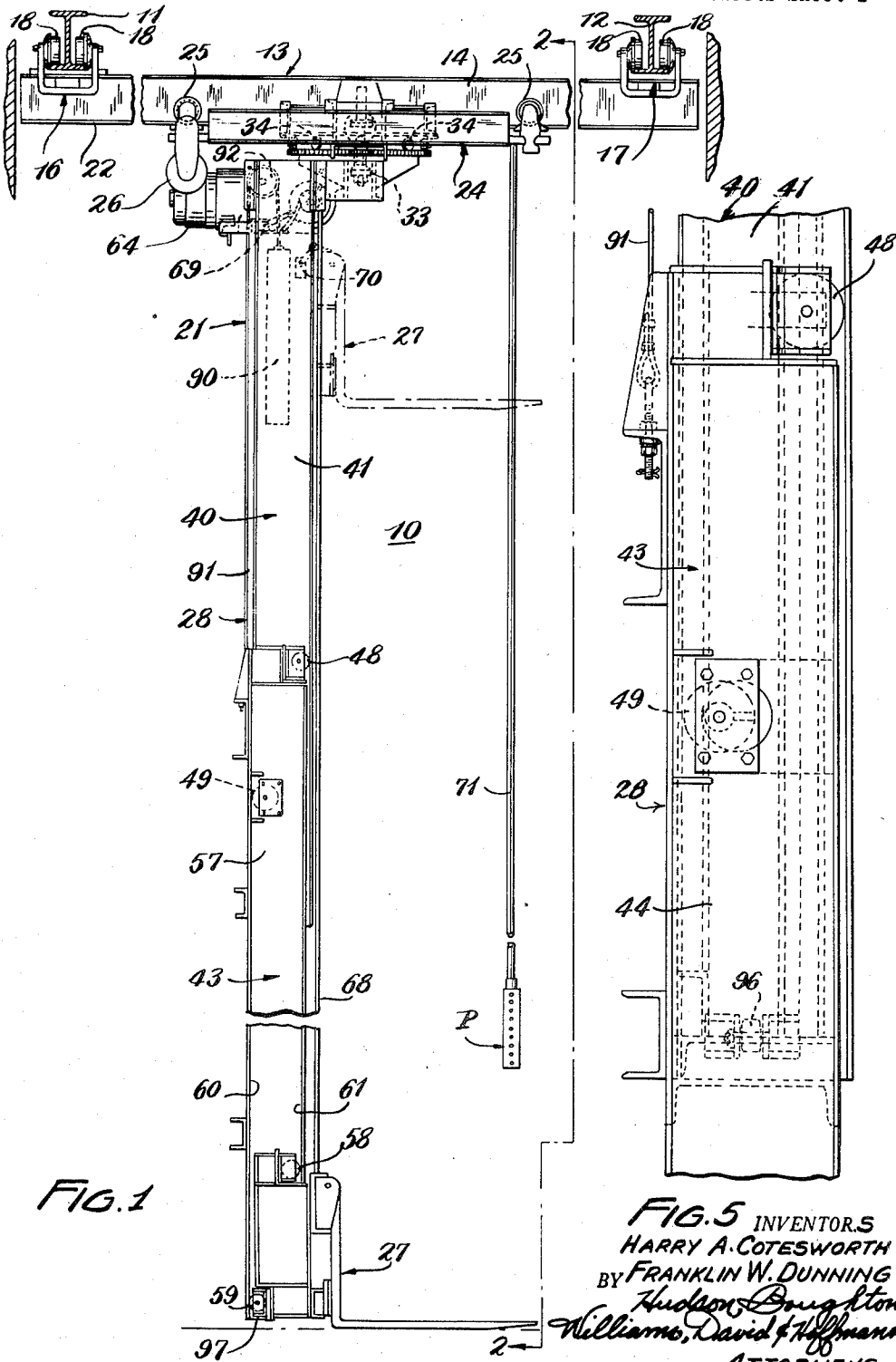
H. A. COTESWORTH ET AL

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CRANE

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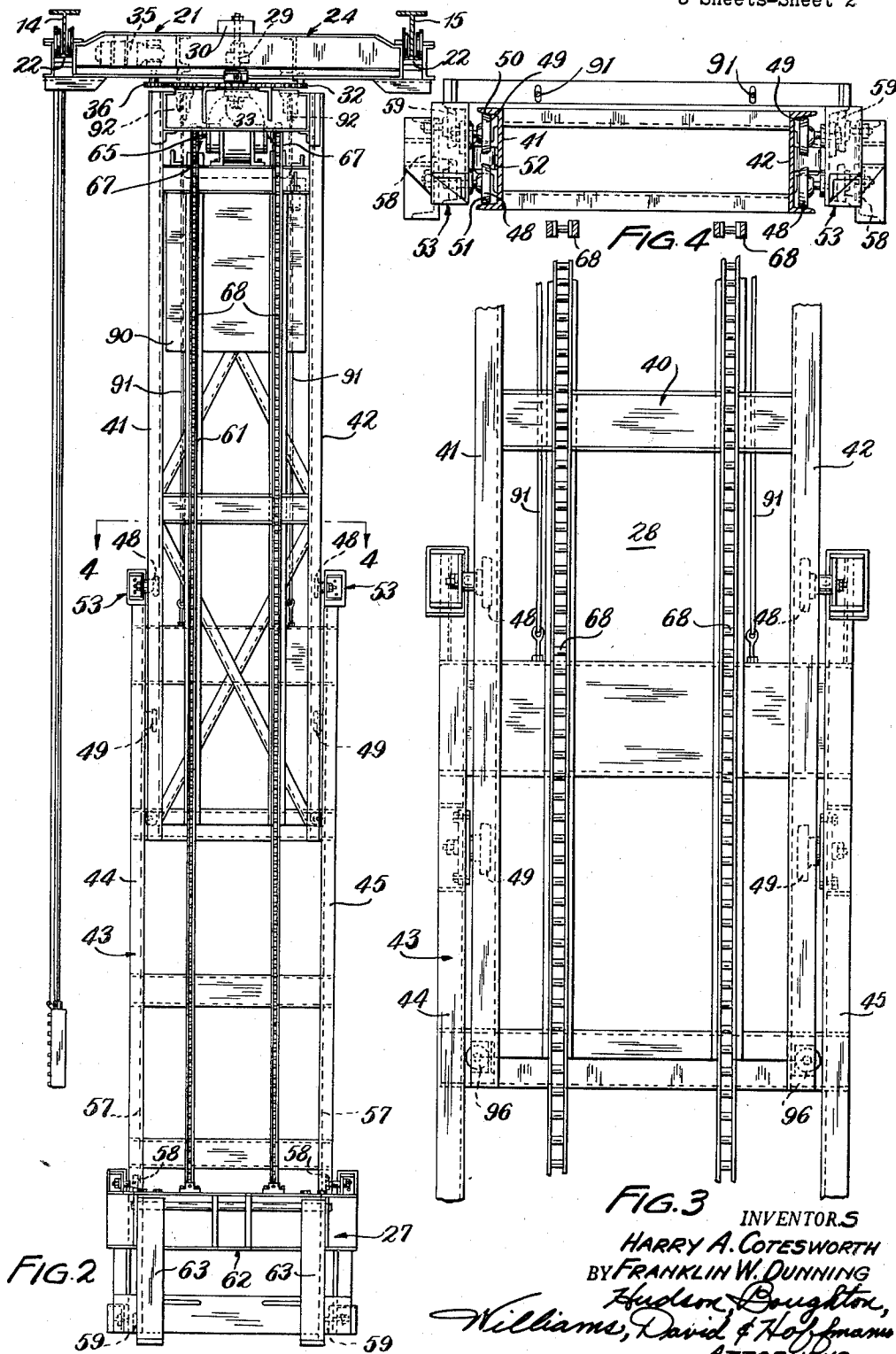


FIG. 3

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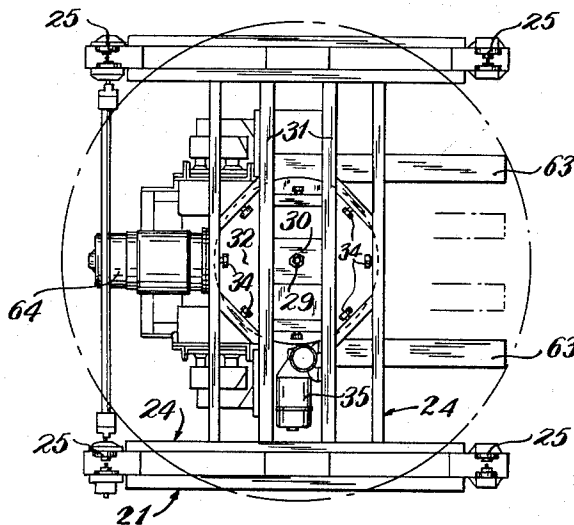


FIG. 6

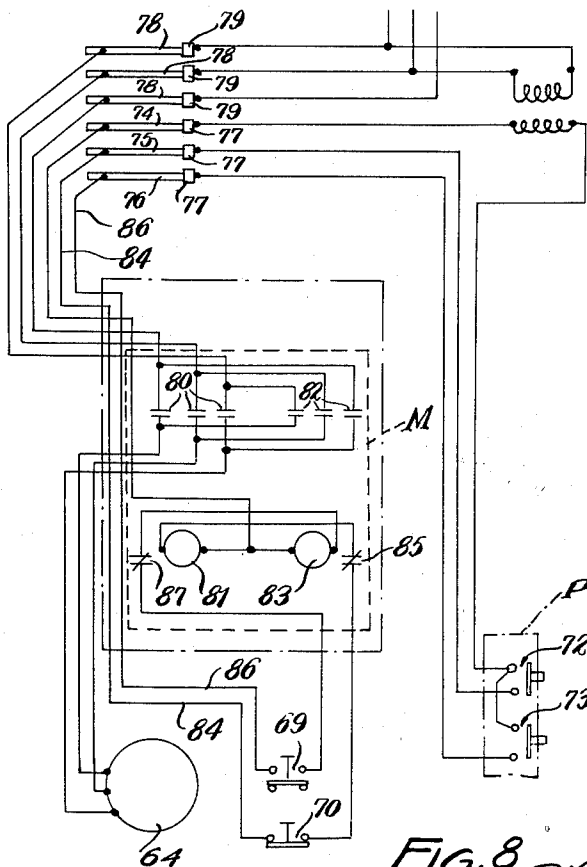


FIG. 8

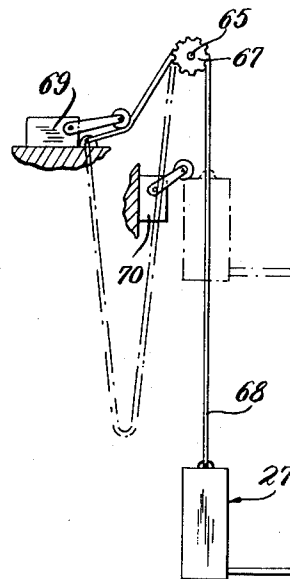


FIG. 7

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6 Claims. (Cl. 212—128)

The present invention relates to an overhead supported material-handling apparatus and, more particularly, to a traveling crane having a vertically movable load carriage and a vertical mast assembly for guiding the movement of the carriage.

An important object of the present invention is the provision of a new and improved overhead supported material-handling apparatus, particularly a traveling crane, having a downwardly extending vertical mast assembly, an elevatable load carriage guided for vertical movement by the mast assembly, and power-actuated means for raising and lowering the carriage, the mast assembly including a vertical primary mast and a secondary mast guided on the primary mast for endwise movement and positionable so as to extend downwardly from the primary mast to provide an extension of the primary mast which is variable by endwise movement of the secondary mast relative to the primary mast, the apparatus being so constructed and arranged that the load carriage can be raised to the upper end of the mast assembly and the secondary mast is raised and lowered with operation of the load carriage.

Another object of the present invention is the provision of a new and improved overhead supported material-handling apparatus, particularly a traveling crane having a downwardly extending vertical mast assembly comprised of primary guides and secondary guides supported for vertical movement by the primary guides from a telescoped relationship with the primary guides to an extended position wherein they project below the lower ends of the primary guides, an elevatable load carriage guided in its vertical movement by the secondary guides, and power-actuated means for raising and lowering the load carriage, and wherein the secondary guides automatically lowered and raised upon operation of the load carriage.

Another object of the present invention is a provision of a new and improved overhead supported material-handling apparatus, particularly a traveling crane having a downwardly extending vertical mast assembly comprised of primary guides and secondary guides supported for vertical movement by the primary guides from a telescoped relationship with the primary guides to project from the lower end of the primary guides, an elevatable load carriage guided in its vertical movement by the secondary guides, and power-actuated means for raising and lowering the load carriage, and wherein the apparatus is so constructed and arranged that the secondary guides are yieldably urged to a telescoped position with the primary guides and are automatically lowered and raised by operation of the load carriage.

The invention resides in certain constructions, combinations and arrangements of parts and further objects and advantages will be apparent to those skilled in the art to which it relates from the following description of the preferred embodiment made with reference to the accompanying drawings forming a part of this specification, in which:

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Fig. 1 is a vertical sectional view through a material-handling system showing in elevation a traveling crane embodying the present invention;

Fig. 2 is a view taken approximately from along line 2—2 of Fig. 1 looking in the direction of the arrows;

Fig. 3 is an enlarged fragmentary view of a portion of Fig. 2;

Fig. 4 is a sectional view taken approximately along line 4—4 of Fig. 2;

Fig. 5 is an enlarged fragmentary view of a portion of Fig. 1;

Fig. 6 is a plan view of the trolley of the apparatus shown in Fig. 1;

Fig. 7 is a schematic view showing the suspension means for the load carriage and the limit switches therefor; and Fig. 8 is a simplified control circuit for the hoist motor.

While the present invention is susceptible of various modifications and constructions, it is herein shown as embodied in a traveling crane 10 supported overhead by spaced rails 11, 12 and movable therealong. The spaced rails 11, 12 form a runway for the traveling crane 10 and may be positioned between rows of bins or shelves for storing articles to be handled by the apparatus.

The traveling crane is shown as comprising a support or bridge 13 including girders 14, 15 that extend transversely of the rails 11, 12 and end trucks 16, 17 connected to the opposite ends respectively of the girders 14, 15. The end trucks 16, 17 include wheels 18 which ride on the tread portions of the rails 11, 12 and support the traveling crane for movement along the rails.

A carrier or trolley 21 is supported on horizontal flange portions or treads 22 of the girders 14, 15 for movement therealong. The trolley 21 includes a frame portion 24 and wheels 25 which support the opposite ends of the frame portion 24 and which ride on the horizontal flanges 22 of the girders 14, 15. The trolley is provided with a motor 26 for driving one set of the wheels 25 to move the trolley along the girders 14, 15 in a conventional manner.

The trolley 21 includes an elevatable load carriage 27 guided and supported in its vertical movement by a vertical revoluble mast assembly 28 dependently supported from the frame portion 24 by a trunnion pin 29. The trunnion pin 29 is supported by a block 30 mounted between transverse frame members 31 of the frame portion 24. The trunnion pin 29 passes through a member 32, a bull gear in the illustrated embodiment, fixed to the upper end of the mast assembly 28 and has a bearing portion 33 positioned below the bull gear 32 which engages the underside of the bull gear and carries the weight of the mast assembly. The frame portion 24 is provided with rollers 34 which engage the upper side of the bull gear 32 and function to stabilize the mast assembly 28. The mast assembly in the illustrated embodiment is rotated by power and a motor 35 is carried by the frame portion 24 and is operatively connected to the mast assembly 28 to rotate the latter through a pinion gear 36 in mesh with the bull gear 32.

The structure thus far described is of conventional construction and has, therefore, not been described in detail, it being understood that other suitable structure may be utilized for supporting the mast assembly 28 for movement overhead and for rotation about a vertical axis.

According to the present invention, the mast assembly 28 comprises a primary mast 40 formed by spaced vertical guide members 41, 42 constituting the sides of the primary mast and a movable secondary mast 43 adapted to telescope over the primary mast 40 and including spaced vertical guide members 44, 45. The guide members 44, 45 are disposed adjacent the opposite sides of the primary mast outwardly of the guide members 41,

42 respectively and each of the guide members 44, 45 supports a pair of wheels 48, 49 which cooperate with the adjacent one of the guide members 41, 42 to guide the movement of the secondary mast 43 with respect to the primary mast 40.

The wheels 48, 49 supported by each of the channel members 44, 45 engage the opposite side walls 50, 51 of a guide channel 52 in the adjacent one of the guide members 41, 42. The side walls 50, 51 are inclined and the wheels 48, 49 are tapered so as to readily roll thereon and so as to limit the inward movement of the wheels with respect to their corresponding channels 52. The wheels 48 are supported at the upper ends respectively of the guide members 44, 45 by bracket assemblies 53 which close the upper ends of the guide channels 44, 45 as shown in Fig. 4, and preferably permit adjustment of the wheels while the wheels 49 are supported intermediate the ends of the channels 44, 45 for rotation about shafts which are supported by the adjacent channel members for adjustment toward and away from the walls 50, 51 of the guide channels 52. The vertical spacing of the wheels 48, 49 prevents rocking movement of the secondary mast assembly about a horizontal axis when the latter is extended to form an extension of the primary mast.

The guide members 44, 45 have outwardly facing guide channels 57 each of which cooperate with a pair of vertically spaced wheels 58, 59 supported on the load carriage 27 adjacent the guide member to guide movement of the carriage with respect to the secondary mast. The channels 57 each have side walls 60, 61 and the rollers 58, 59 engage the side walls 60, 61 respectively of the adjacent channel.

The load carriage 27 includes a transverse frame 62 extending transversely of the mast assembly 28 and a pair of load engaging fork members 63 carried by the transverse frame. The fork members 63 are preferably detachably connected to the frame 62 and are preferably adjustable toward and away from each other to vary the spacing between the fork members. The load carriage 27 is raised and lowered by operation of a hoist motor 64 supported at the upper end of the primary mast 40 and connected to an output shaft 65 extending transversely of the primary mast of a gearing within housing G. The opposite ends of the drive shaft 65 mount sprockets 67 and the carriage 27 is suspended by flexible members or chains 68 which are secured at one end to the primary mast 40 and are trained over the sprockets 67 and connected at their other ends to the load carriage 27. Rotation of the motor 64 will either raise or lower the load carriage 27, depending upon the direction of rotation.

When the load carriage 27 is in its lowermost position, the portions of the chains 68 between the sprockets 67 and the primary mast are relatively straight and when the motor 64 is operated to raise the load carriage 27, these portions form loops between the guide channels 41, 42.

The condition of the chains 68, is in the illustrated embodiment, utilized to actuate a limit switch 69 for stopping the motor 64 when the carriage 27 obtains its lowermost position. As is best shown in Fig. 7, the limit switch 69 is mounted on the primary mast 40 adjacent the fixed end of one of the chains 61 and when the portion of the chain between the sprockets and the primary mast is shortened sufficiently, the limit switch is actuated by the adjacent chain to stop the motor 64.

The uppermost position of the load carriage 27 is determined by a limit switch 70 mounted adjacent of upper end of one of the channels 50 of the secondary mast 43 and actuated by the carriage when the latter is moved to a position adjacent the upper end of the secondary mast 43 to stop the elevating operation of the motor 64.

A simplified control circuit for the hoist motor 64 is shown in Fig. 8. The motor 64 is controlled from a pendant control station P suspended from the trolley 21

by a flexible cable 71 and also adapted to control the operation of the motor 35 for revolving the mast assembly 28. The control station P is provided with a push button switch 72 actuatable to effect the raising of the load carriage 27 and a push button switch 73 actuatable to effect the lowering of the load carriage. The connections between the switches 72, 73 and the motor 64 on the mast assembly are made through collector rings 74, 75, 76 about the trunnion pin 29 and rotatable with the mast assembly and stationary cooperating brushes 77.

As shown in Fig. 8, three collector rings 78 and cooperating brushes 79 are also provided for supplying three-phase power to a motor contactor panel M for the hoist motor 64. The panel M includes a set of contacts 80 which are actuated by the energization of a relay coil 81 to operate the hoist motor 64 in one direction and a set of contacts 82 which are actuated by the energization of a relay coil 83 to operate the motor 64 in the opposite direction. The collector ring 74 is continuously energized and is connected to one side of each of the relay coils 81, 83 and the relays are energized when the corresponding one of the push button switches 72, 73 is depressed to apply a potential to the corresponding one of the collector rings 75, 76. When the push button switch 72 is depressed, the collector ring 75 is energized to cause the energization of relay 81 through a connection 84 which includes the limit switch 70 and normally closed contacts 85 which are mechanically interlocked with the contacts of relay coil 83 to open upon the energization of the latter. Similarly, the relay coil 83 is energized to effect lowering of the carriage, when the push button 73 is depressed to apply a potential to collector ring 76, through a connection 86 which includes the limit switch 69 and normally closed contacts 87 mechanically interlocked to operate with the contacts 80 of the relay coil 81 for raising the carriage. It can now be seen that the operation of either of the limit switches 69, 70 will stop the operation of the motor in the direction of movement necessary to actuate the switch. The control circuit, however, will be so conditioned that the carriage may be moved in the opposite direction. As soon as the carriage is moved in the opposite direction, after actuation of one of the limit switches 69, 70, the switch will close and the hoist motor can then be operated in either direction.

As the load carriage 27 is elevated from its lowermost position, shown in Fig. 1, the secondary mast 43 is raised by the action of a counterweight 90. The counterweight 90 is connected to the secondary mast 43 by cables 91 which extend over pulleys 92 supported at the upper end of the primary mast 40. The counterweight 90 is positioned between the guide channels 41, 42 and when the load carriage 27 is in its lowermost position, the counterweight is in its uppermost position and is disposed adjacent the upper end of the mast 40. As the carriage 27 is raised from its lowermost position the mast 43 telescopes upwardly over the mast 40 until the upper end of mast 43 is disposed adjacent the upper end of the primary mast 40. At this point, a portion of the lower end of the secondary mast abuts the primary mast to stop the upward movement of the latter and the continued operation of the motor 26 for raising the carriage will cause relative movement of the carriage 27 with respect to both the secondary mast 43 and the primary mast 40. The secondary mast is preferably guided by rollers 96, in addition to wheels 48, 49, supported at the lower ends of the primary mast 40 so as to engage the guide members 44, 45.

The lower ends of the guide channels 44, 45 are partially closed by plates 97 which are engaged by the load carriage 27 when the latter is lowered. The plates 96 transfer a part of the weight of the load carriage to the secondary mast 43 to cause the latter to move with the load carriage as the latter is lowered below the primary mast 40. It will be noted that the weight of the

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load carriage 27 is such that it will overcome the counterbalancing effect of the counterweight 90 when the carriage engages the plates 97.

It can now be seen that the fork members 63 may be moved transversely of an aisle along which the rails 11, 12 are supported by operation of the trolley 21 and may be moved along the aisle by moving the traveling crane along the rails 11, 12. The carriage is also elevatable by operation of the motor 64 and, as the load carriage is raised from its lowermost position, the lower portion of the mast assembly 40 elevates with the load carriage and telescopes over the upper portion of the mast assembly for the first part of the movement and after the secondary mast is in its uppermost position, the load carriage moves relative to both the primary and secondary masts as it continues its upward movement. The provision of a mast assembly as described in the application provides a traveling crane of the type described which is useable where it is necessary or desirable to move the apparatus past obstructions which extend above the lowermost position of the carriage. Since the secondary mast retracts automatically, it is not necessary for the operator to concern himself with controls to retract the secondary mast when such an obstruction is imminent or anticipated. The fact that the upper ends of the guide members 40, 45 are closed by the brackets 53 prevents any possibility of the secondary mast 43 dropping below the load carriage 27 in the event the counterweight cables should break with the load carriage near the upper end of the mast. In this event, the brackets 53 would catch on the wheels 58 or the upper part of the load carriage 27 and prevent further relative movement between the parts. This construction also permits the counterweight 90 to be eliminated in which event the secondary mast 43 remains in its down position until the load carriage 27 is raised to the upper end of the secondary mast at which time the wheels 58 or upper part of the load carriage 27 engage the brackets 53 and upon continued upward movement of the load carriage 27, the secondary mast is carried upwardly with it.

While the revolvable mast assembly shown in the drawings is actuated by power and while power-actuated means is provided for moving the traveling crane along the lines 11, 12, it will be understood by those skilled in the art that the apparatus may be constructed so that these operations are performed manually. It will also be understood that the hoist motor for elevating the carriage and the secondary mast may be replaced by a manually operated hoist if such is deemed desirable.

While a preferred form of the invention has been described in considerable detail, it will be apparent that the invention is not limited to the construction shown or the uses referred to and it is my intention to cover hereby all adaptations, modifications, and changes which come within the practice of those skilled in the art to which the invention relates and the scope of the appended claims.

Having thus described our invention, we claim as follows:

1. In a material handling apparatus a movable overhead support, a vertical mast assembly comprising a plurality of relatively movable mast sections, means connecting the upper end of one of said mast sections to said overhead support for rotation about a vertical axis, means operatively connecting another of said mast sections to said one of said mast sections for movement relative thereto between a position in which its lower end is below the lower end of said one of said mast sections and a position in which its upper end is adjacent to said overhead support, a load carriage, a load engaging member connected to said load carriage, means for connecting said load carriage to said another of said mast sections for movement thereof and said load engaging member therealong between positions adjacent to the upper and lower ends of said another of said mast sec-

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tions, and means for raising said load carriage and said load engaging member above said position adjacent to the lower end of said another of said mast sections and said another of said mast sections above said position in which its lower end is below the lower end of said one of said mast sections.

2. In a material handling apparatus a movable overhead support, a vertical mast assembly comprising a plurality of relatively movable mast sections, means connecting the upper end of one of said mast sections to said overhead support for rotation about a vertical axis, means operatively connecting another of said mast sections to said one of said mast sections for movement relative thereto between a position in which its lower end is below the lower end of said one of said mast sections and a position in which its upper end is adjacent to said overhead support, a load carriage, a load engaging member connected to said load carriage, means for connecting said load carriage to said another of said mast sections for movement thereof and said load engaging members therealong between positions adjacent to opposite ends of said another of said mast sections, and power means carried by said overhead support and connected by a flexible means to said load carriage for raising said load carriage and said load engaging member above said position adjacent to the lower end of said another of said mast sections and said another of said mast sections above said position in which its lower end is below the lower end of said one of said mast sections.

3. In a material handling apparatus a movable overhead support, a vertical mast assembly comprising a plurality of relatively movable mast sections, means connecting the upper end of one of said mast sections to said overhead support for rotation about a vertical axis, means operatively connecting another of said mast sections to said one of said mast sections for movement relative thereto between a position in which its lower end is below the lower end of said one of said mast sections and a position in which its upper end is adjacent to said overhead support, a load carriage, a load engaging member connected to said load carriage, means for connecting said load carriage to said another of said mast sections for movement thereof and said load engaging member therealong between positions adjacent to opposite ends of said another of said mast sections, means for raising said load carriage and said load engaging member from said position adjacent to the lower end of said another of said mast sections to said position adjacent to the upper end thereof, and abutment means on said load carriage and said another of said mast sections for preventing movement of said load carriage relative to said another of said mast sections beyond said positions.

4. In a material handling apparatus a movable overhead support, a vertical mast assembly comprising a plurality of relatively movable mast sections, means connecting the upper end of one of said mast sections to said overhead support for rotation about a vertical axis, means operatively connecting another of said mast sections to said one of said mast sections for movement relative thereto between a position in which its lower end is below the lower end of said one of said mast sections and a position in which its upper end is adjacent to said overhead support, a load carriage, a load engaging member connected to said load carriage, means for connecting said load carriage to said another of said mast sections for movement therealong between positions adjacent to opposite ends of said another of said mast sections, means for yieldably urging said another of said mast sections in an upwardly direction, means for raising said load carriage and said load engaging member above said position adjacent to the lower end of said other of said mast sections, and abutment means on said load carriage and said another of said mast sections for limiting move-

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ment of said load carriage relative to said other of said mast sections in a downwardly direction beyond its said position adjacent to the lower end of said another of said mast sections.

5. In a material handling apparatus a movable overhead support, a vertical mast assembly comprising a plurality of relatively movable mast sections, means connecting the upper end of one of said mast sections to said overhead support for rotation about a vertical axis, means operatively connecting another of said mast sections to said one of said mast sections for movement relative thereto between a position in which its lower end is below the lower end of said one of said mast sections and a position in which its upper end is adjacent to said overhead support, a load carriage, a load engaging member connected to said load carriage, means for connecting said load carriage to said another of said mast sections for movement therealong between positions adjacent to opposite ends of said another of said mast sections, means for yieldably urging said another of said mast sections in an upwardly direction, power means carried by said overhead support and connected by a flexible means to said load carriage for raising said load carriage and said load engaging member above said position adjacent to the lower end of said another of said mast sections, and

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abutment means on said load carriage and said another of said mast sections for limiting movement of said load carriage relative to said another of said mast sections in a downwardly direction beyond its said position adjacent to the lower end of said other of said mast sections.

6. In a material handling apparatus as called for in claim 5, wherein the means for yieldably urging said another of said mast sections in an upwardly direction includes a counterweight connected by a flexible means to said another of said mast sections.

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